United States
Department of
Agriculture

**Agricultural
Research
Service**

ARS–165

September 2005

Evaluation of New Canal Point Sugarcane Clones

2003-2004 Harvest Season

Abstract

Glaz, B., J.C. Comstock, P.Y.P. Tai, S.J. Edme, R. Gilbert, J.D. Miller, and J.O. Davidson. 2003. Evaluation of New Canal Point Sugarcane Clones: 2003-2004 Harvest Season. U.S. Department of Agriculture, Agricultural Research Service, ARS-165.

Thirty-two replicated experiments were conducted on 11 farms (representing five organic soils and two sand soils) to evaluate 54 new Canal Point (CP) clones of sugarcane from the CP 99, CP 98, CP 97, and CP 96 series. Experiments compared the cane and sugar yields of the new CP 99 and CP 98 clones, complex hybrids of *Saccharum* spp., with yields of CP 72-2086, the fifth most widely grown sugarcane cultivar in Florida. Yields of all other new clones were compared with those of CP 70-1133, formerly a major commercial sugarcane cultivar in Florida. Other reference cultivars were CP 89-2143 (for CP 99 and 98 series on organic soils) and CP 78-1628 (for CP 99 and 98 series on sand soils) Each clone was rated for its susceptibility to diseases and cold temperatures. Based on results of these and previous years' tests, it has been recommended to release CP 97-1944 and CP 97-1989 for commercial production in Florida.

The audience for this publication includes growers, geneticists and other researchers, extension agents, and individuals who are interested in sugarcane clone development.

Keywords: Histosol, muck soil, organic soil, *Puccinia melanocephala, Saccharum* spp., stability, sugarcane cultivars, sugarcane rust, sugarcane smut, sugarcane yields, sugar yields, *Sporisorium scitaminea.*

While supplies last, single copies of this publication can be obtained at no cost from Barry Glaz, Sugarcane Field Station, 12990 U.S. Highway 441N, Canal Point, FL, 33438; or by e-mail at bglaz@saa.ars.usda.gov.

Copies of this publication may be purchased in various formats (microfiche, photocopy, CD, print on demand) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (800) 553-6847, www.ntis.gov.

Acknowledgments

The authors acknowledge the assistance of Velton Banks, Billy Jay Cruz, Matthew Paige, and Kenneth Peterkin of the Florida Sugar Cane League, Inc., in conducting the fieldwork described herein; and of Jennifer Vonderwell of USDA-ARS for managing the laboratory work and conducting much of the data management and analyses necessary to organize this report. The authors also express their appreciation to the growers who provided land, labor, cultivation, and

September 2005

other support for these experiments.

Contents

Evaluation Of New Canal Point Sugarcane Clones

2003-2004 Harvest Season

B. Glaz, J.C. Comstock, P.Y.P. Tai, S.J. Edme, R. Gilbert, J.D. Miller, and J.O. Davidson

Breeding and selection for clones that can be used for commercial production of sugarcane, complex hybrids of *Saccharum* spp., support the continued success of this crop in Florida. Though production of sugar per unit area is a principal selection characteristic, it is not the only factor on which sugarcane is evaluated. In addition, analyses are made on the concentration of sugar and on the fiber content of the cane. The economic value of each clone integrates its harvesting, transportation, and milling costs with its expected returns from sugar production. Deren et al. (1995) developed an economic index for clonal evaluation in Florida. Evaluation of clonal suitability also includes its reactions to endemic pathogens.

The time of year and the duration that a clone yields its highest amount of sugar per unit area is important because the Florida sugarcane harvest season extends from October to April. Because sugarcane is commercially grown in plant and ratoon crops, clones are evaluated accordingly. Adaptability to mechanical harvesters is an important trait in Florida. Mechanically harvested stalks are either sent to mills to extract their sugar or used for planting new sugarcane fields.

Information about the stability of a clone's performance aids in selecting clones that will yield well across most environments. Stability measurements also enable identification of clones that will perform well only in some environments. This stability factor is important in our evaluations because of the range of environments for growing sugarcane in Florida. As differences widen for such characteristics as temperature, moisture, and soil, region-specific clones become more desirable because few clones produce high yields in markedly different environments. Glaz et al. (2002a) reported that performance of clones between the final two stages of the selection program at Canal Point was generally stable.

Clones with desired agronomic characteristics also must be productive in the presence of harmful diseases, insects, and weeds. Some pathogens rapidly develop new, virulent races or strains. Because of these changes in pathogen populations, clonal resistance is not considered permanent. The selection team must try not to discard clones that have sufficient resistance or tolerance to pests, but it also must discard clones that are too susceptible to pests to be grown commercially.

The disease that has caused the most difficulty in Florida in selecting resistant sugarcane cultivars has been sugarcane rust, caused by *Puccinia melanocephala* Syd & P. Syd. Florida sugarcane growers and scientists have had the most success in selecting resistant cultivars for sugarcane smut, caused by *Sporisorium scitaminea* Syd and P. Syd. Other diseases they must contend with are leaf scald, caused by *Xanthomonas albilineans* (Ashby) Dow; sugarcane yellow leaf virus, a disease caused by a luteovirus (Lockhart et al. 1996); and sugarcane mosaic strain E. Ratoon stunting, caused by *Leifsonia xyli* subsp. *xyli* Evtsuhenko et al. has probably been the most damaging, though the least visible, sugarcane disease in Florida. A program to improve resistance of CP clones to ratoon stunting is underway (Comstock et al. 2001).

Scientists at Canal Point also screen clones in their selection program for resistance to rust, smut, leaf scald, mosaic, ratoon stunting, and eye spot caused by *Bipolaris sacchari* (E.J. Butler) Shoemaker. Eye spot is not currently a commercial problem in Florida.

Sugarcane growers in Florida rely much more on tolerance to sugarcane diseases than on resistance. In the 2003 growing season, 10 cultivars made up 86.5 percent of Florida's sugarcane (Glaz and Vonderwell 2004). Nine of these 10 cultivars—CL 61-620,

Glaz is research agronomist, Comstock is research plant pathologist, Tai and Miller are retired research geneticists, and Edme is research geneticist, U.S. Department of Agriculture, Agricultural Research Service, U.S. Sugarcane Field Station, Canal Point, FL. Gilbert is assistant professor in agronomy, Everglades Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, FL. Davidson was research assistant, Florida Sugar Cane League, Inc., Clewiston, FL.

CP 70-1133, CP 72-2086, CP 73-1547, CP 78-1628, CP 80-1743, CP 84-1198, CP 88-1762, and CP 89-2143—were susceptible to one or more of the following sugarcane diseases: rust, mosaic, leaf scald, smut, or ratoon stunting. Only CL 77-797 was not susceptible to any of these diseases. Glaz et al. (1986) presented a formula and procedure to help growers distribute their available sugarcane cultivars while considering possible attacks of new pests.

Some growers minimize losses by planting stalks that do not contain the bacteria that causes ratoon stunting. This can be accomplished by planting with stalks that have been treated with hot-water therapy that kills the ratoon stunting bacteria or by planting disease-free stalks derived from meristem tissue culture.

Damaging insects in Florida are the sugarcane borer, *Diatraea saccharalis* (F.); the sugarcane lace bug, *Leptodictya tabida;* the sugarcane wireworm, *Melanotus communis*; the sugarcane grub, *Ligyrus subtropicus;* and the west indian cane weevil, *Metamasius hemipterus* (L.).

Geneticists at Canal Point are working to incorporate borer resistance into the breeding program by selecting for leaf pubescence (a trait known to promote resistance) in elite sugarcane clones (Sosa 1996). Currently, we know of no commercial sugarcane cultivars with pubescent leaves. In addition, the heritability of resistance to sugarcane borers through means other than leaf pubescence is sufficiently high that improvements in this characteristic are possible (White et al. 2001).

Winter freezes are common in the region of Florida where much of the sugarcane is produced. The severity and duration of a freeze and the tolerance of specific sugarcane cultivars are the major factors that determine how much damage occurs. The damage caused by such freezes ranges from no damage to death of the mature sugarcane plant. The rate of deterioration of juice quality after a freeze depends on the ambient air temperature: Warmer post-freeze temperatures result in more rapid deterioration of juice quality. Freezes also damage young sugarcane plants. Stalk populations may decline after severe freezes kill aboveground parts of recently emerged plants. The most severe damage occurs when the growing point is frozen, which is more likely if it has emerged from the soil. Tai and Miller (1996) reported that resistance to a light freeze (-1.7 °C to -2.8 °C) was not significantly correlated to fiber content, but resistance to a moderate freeze (-5.0 °C) was.

Each year at Canal Point, 50,000 to 100,000 seedlings are evaluated from crosses derived from a diverse germplasm collection. However, Deren (1995) suggested that the genetic base of U.S. sugarcane breeding programs was too narrow. About 85 percent of the cytoplasm in commercial sugarcane is *Saccharum officinarum*. This year, most of the parental clones in our program originated from Canal Point. In addition, clones used as parents this season came from Louisiana and Texas and from Argentina, India, and New Guinea. Also, *Erianthus* spp., *Miscanthus* spp., *Saccharum officinarum,* and *Saccharum spontaneum* clones were used in introgression programs to develop interspecific and intergeneric hybrids that were used as parents this year.

About 12 percent of 100,000 seedlings from the seedling stage were advanced to the stage I phase in 2004. In addition, about 3,000 clones from the private program in Clewiston, FL, were planted in the stage I phase at Canal Point this year. About 10 percent of the 15,000 clones in stage I were advanced to stage II. The clones in stage II were visually selected in the seedling and stage I phases. Once selected as seedlings, clones are vegetatively propagated. Because of this vegetative propagation, from this stage on in the selection program each plant (clone) is genetically identical to its precursor, assuming no mutations. From the 1,600 clones in stage II, 102 were selected for continued testing in replicated experiments. Each of the first three stages (seedling, stage I, and stage II) were evaluated for 1 year in the plant-cane crop at Canal Point. The primary selection criteria for stage II and all subsequent stages are sugar yield (metric tons per hectare), theoretical recoverable sucrose, cane production, and disease resistance.

Normally, 135 clones are advanced from stage II to stage III. This year, only 102 CP clones were advanced

because 33 clones from the breeding program of the United States Sugar Corp. (USSC), based in Clewiston, Florida, were transferred to stage III of the Canal Point program. The USSC program was recently discontinued, and its clones are also being transferred to other stages of the Canal Point program. Clones from the USSC program have traditionally been designated with a CL prefix. Once these CL clones are transferred to Canal Point, their designation will be CPCL, and they will retain their USSC numbers. None of the USSC clones are described in this report because they have not yet been advanced to stage IV.

The 135 stage III clones are evaluated for 2 years, in the plant-cane and first-ratoon crops, in commercial sugarcane fields, at four locations—three with organic soils and one with a sand soil. The 14 most promising clones identified in stage III receive continued testing for 4 more years in the stage IV experiments where they are planted in successive years and evaluated in the plant-cane, first-ratoon, and second-ratoon crops. Clones that successfully complete these experimental phases undergo 2 to 4 years of evaluation and expansion by the Florida Sugar Cane League, Inc., before commercial release. Some of the League's evaluation occurs concurrently with the stage IV evaluations. The Canal Point selection program is summarized in appendix 1.

Clones with characteristics that may be valuable for sugarcane breeding programs are identified throughout the selection process. Sugarcane geneticists in other programs often request clones from Canal Point. From May 2003 to April 2004, CP clones or seeds were requested from and sent to the Dominican Republic, Ecuador, India, Mali, Myanmar, Pakistan, Panama, and the People's Republic of China. California also received CP clones.

This report summarizes the cane production and sugar yields of the clones in the plant-cane, first-ratoon, and second-ratoon stage IV experiments sampled in Florida's 2003-2004 sugarcane harvest season. This information is used to identify commercial cultivars and clones with useful characteristics for the Canal Point and other sugarcane breeding programs, and it is used by representatives of other sugar industries to request Canal Point clones.

Test Procedures

In 32 experiments, 54 new CP clones were evaluated. In the plant-cane crop, 14 clones of the CP 99 series were evaluated at nine farms and 14 clones of the CP 98 series were evaluated at two farms. Fourteen clones of the CP 98 series were evaluated in the first-ratoon crop at six farms. Also evaluated were 14 clones of the 97 series at four farms and 1 clone of the CP 97 series at two farms in the first-ratoon crop. Fourteen clones of the CP 97 series in the second-ratoon crop were evaluated at seven farms and 1 clone of the CP 97 series was evaluated at two farms. At four farms, 11 clones of the CP 96 series in the second-ratoon crop were evaluated.

CP 72-2086 was the primary reference clone in the plant-cane and first-ratoon experiments of the CP 99 and 98 series. CP 72-2086 was the fourth most widely grown cultivar on organic soils and fifth most widely grown cultivar overall in Florida in 2003 (Glaz and Vonderwell 2004). In the plant cane experiments of the CP 99 series, CP 89-2143 on organic soils and CP 78-1628 on sand soils were secondary reference clones. CP 89-2143 was the second most widely grown cultivar on organic soils and CP 78-1628 the most widely grown on sand soils in Florida in 2003 (Glaz and Vonderwell 2004). CP 70-1133 was the primary reference clone in all other experiments. CP 70-1133 was the fourteenth most widely grown sugarcane cultivar in Florida in the 2003-2004 harvest season, but for several years earlier was the most widely grown cultivar in Florida (Glaz and Vonderwell 2004).

The plant cane and first-ratoon experiments at A. Duda and Sons, Inc., (Duda) southeast of Belle Glade were conducted on Dania muck. Also, the first-ratoon experiments at Sugar Farms Cooperative North—Osceola Region S03 (Osceola) east of Canal Point and at Okeelanta Corporation (Okeelanta) were conducted on Dania muck. As described by Rice et al. (2002), Dania muck is the shallowest of the organic soils composed primarily of decomposed sawgrass (*Cladium jamaicense* Crantz) in the Everglades Agricultural Area.

The maximum depth to bedrock of Dania muck is 51 cm. The other organic soils similar to Dania muck are Lauderhill muck (51 to 91 cm to bedrock), Pahokee muck (91 to 130 cm to bedrock), and Terra Ceia muck (more than 130 cm to bedrock).

All experiments at Sugar Farms Cooperative North—SFI Region S05 (SFI) near 20-Mile Bend in Palm Beach County were conducted on Lauderhill muck. Also, the plant-cane and second-ratoon experiments at Okeelanta, at Knight Management, Inc., (Knight) southwest of 20-Mile Bend, and at Wedgworth Farms, Inc., (Wedgworth) east of Belle Glade were conducted on Lauderhill muck, as was the second-ratoon experiment at Duda.

A plant-cane experiment at Okeelanta was conducted on Pahokee muck. All experiments at United States Sugar Corporation—Ritta Sec 35-31 (Ritta) east of Clewiston, the plant-cane and first-ratoon experiments at Osceola, and the first-ratoon experiment at Knight were conducted on Terra Ceia muck.

The three experiments at Eastgate Farms, Inc., (Eastgate) north of Belle Glade were on Torry muck. The three experiments at Hilliard Brothers of Florida, Ltd., (Hilliard) west of Clewiston were on Malabar sand. The three experiments at Lykes Brothers, Inc., farm (Lykes) near Moore Haven in Glades County were on Pompano fine sand.

The CP 98 series plant-cane, the CP 97 series first-ratoon, and the CP 96 series second-ratoon experiments at Okeelanta were planted on fields in successive sugarcane rotations. In this rotation in Florida, a new crop of sugarcane is planted within about 2 months of the previous sugarcane harvest. All other experiments were planted in fields that had not been cropped to sugarcane for approximately 1 year. In all experiments, clones were planted with two lines of seed cane per furrow in plots arranged in randomized-complete-block designs. All plant-cane and first-ratoon experiments and the CP 97 second-ratoon experiments had six replications. All CP 96 second-ratoon experiments had eight replications.

Each plot had three rows, a border row, and two inside rows used for yield determination. These two rows were 10.7 m long and 3 m wide (0.0032 ha). The distance between rows was l.5 m, and 1.5-m alleys separated the front and back ends of the plots. The outside row of each plot was a border row and was usually planted with the same clone as the inside two rows. An extra 1.5 m of sugarcane protected each row at the front and back of each test.

Agronomic practices, such as fertilization, pest and water control, and cultivation were conducted by the farmer or farm manager responsible for the field in which each experiment was planted.

Samples of 10 stalks were cut from unburned cane from all plots in each experiment between Oct. 15, 2003, and Feb. 19, 2004. In all experiments, these samples were cut from the middle row of each plot. In addition, preharvest samples were cut from two replications of nine plant-cane experiments between Oct. 13 and Nov. 10, 2003. Once a stool of sugarcane was chosen for cutting, the next 10 stalks in the row were cut as the 10-stalk sample. The range of sample dates for each crop was as follows:

Plant-cane crop	Dec. 2, 2003, to Feb. 28, 2004
First-ratoon crop	Oct. 26, 2003, to Feb. 19, 2004
Second-ratoon crop	Oct. 15, 2003, to Feb. 18, 2004

After each stalk sample was transported to the Agricultural Research Service's Sugarcane Field Station at Canal Point, FL, for weighing and milling, crusher juice from the milled stalks was analyzed for Brix and pol, and theoretical recoverable yield of 96° sugar (in kg per metric ton of cane: KS/T) was determined as a measure of sugar content. The fiber percentage of each clone was used to calculate theoretical recoverable yield (Legendre 1992).

Total millable stalks per plot were counted between May 21 and Sept. 8, 2003. Cane yields (in metric tons per hectare: TC/H) were calculated by multiplying stalk weights by number of stalks. Theoretical yields of sugar (in metric tons per hectare: TS/H) were calculated by multiplying TC/H by KS/T and dividing by 1,000.

Prior to their advancement to stage IV, clones were evaluated by artificial inoculation for susceptibility to sugarcane smut, sugarcane mosaic virus, leaf scald, and ratoon stunting. Clones were inoculated in stage II plots to determine eye spot susceptibility. Since being advanced to stage IV, separate artificial-inoculation tests were repeated for smut, ratoon stunting, mosaic, and leaf scald. Each clone was also field rated for its early plant height, tillering, and shading, as well as for its reactions to natural infection by sugarcane smut, sugarcane rust, sugarcane mosaic virus, and leaf scald in stage IV.

To determine cold tolerance, CP clones were subjected to cold temperatures in several field and walk-in freezer experiments. The clones in the CP 99 series were tested 0, 15, 27, and 41 days after a 4-hour exposure on Feb. 22, 2004, to -19 °C in a walk-in freezer at Canal Point. The clones in the CP 98 series were tested in four separate experiments for cold tolerance; two experiments sampled on Dec. 12, 2003, and Feb. 22, 2004, after 4-hour exposures to -4.4 °C and -19 °C respectively in a walk-in freezer at Canal Point. The other experiments were conducted at the Florida Institute of Food and Agricultural Sciences' Hague Agronomy Farm (Hague) in Gainesville. The experiments were planted in randomized complete blocks with six replications. Plots were 1.5 m long and 2.1 m wide. Samples were collected on Dec. 6, 2003, and Jan. 30, 2004, following recorded air temperatures between -2.2 °C and -4.4 °C for several hours.

The clones in the CP 97 series were tested on Jan. 10, Mar. 29, and Dec. 12, 2002, for cold tolerance 4 weeks after 5-hour exposure to -4.4 °C in a walk-in freezer at Canal Point. The clones in the CP 96 series were tested in two separate experiments at Hague following exposure to temperatures below -3.9 °C on Nov. 22 and 23 and Dec. 18, 20, 21, and 31, 2000. Stalk samples were cut for analyses of sucrose content on Nov. 30, 2000, and Jan. 11, 2001.

Cold-tolerance rankings were based on deterioration of juice quality after the freeze damage to mature sugarcane stalks. However, the clones at Hague had considerable differences in maturity at the time of the freezes and samples. Level of maturity probably affected degree of cold injury and subsequent deterioration of juice quality.

Statistical analyses of the stage IV experiments were based on a mixed model using SAS software (SAS version 9.0, 2003; SAS Institute, Cary, NC) with clones as fixed effects and locations as random effects (SAS 1999). Least squares means were calculated for each clone by location combination. Means of each clone over all locations and each location over all clones are estimated by empirical best linear unbiased predictors. The source of variation that corresponded to the error term for the effect being tested was used to calculate the least significant difference *(LSD).* Significant differences were sought at the 10 percent probability level, and *LSD* was used in all analyses, regardless of significance of F-ratios, to protect against high type-II error rates (Glaz and Dean 1988).

Analyses of clonal stability across locations were done by using procedures recommended by Shukla (1972) at the 10 percent probability level. The higher the Shukla stability estimate, the less stable the clone. Thus, a clone with a low Shukla value would be expected to produce relatively constant yields across locations.

Results and Discussion

Table 1 lists the parentage, percentage of fiber, and reactions to smut, rust, leaf scald, mosaic, and ratoon stunting for each clone included in these experiments. Tables 2-5 contain the results of the CP 99 plant-cane experiments, and tables 6-7 contain the results of the CP 98 plant-cane experiments. Tables 8-10 contain the results of the CP 98 first-ratoon experiments, and tables 11-12 contain the results of the CP 97 first-ratoon experiments. Tables 13-15 contain the results of the

CP 97 second-ratoon experiments, and tables 16-17 contain the results of the CP 96 second-ratoon experiments. Table 18 gives cold-tolerance ratings for the clones in the CP 96, CP 97, CP 98, and CP 99 series. Table 19 gives the dates that stalks were counted in each experiment.

Plant-Cane Crop, CP 99 Series

When averaged across all nine locations, CP 99-2099, CP 99-1893, CP 99-1534, CP 99-1894, and CP 99-1686 yielded significantly more TS/H (metric tons of sugar per hectare) and TC/H (metric tons of cane per hectare) than CP 72-2086 (tables 2 and 5). Each of these new clones had significantly lower preharvest and harvest KS/T yields than CP 89-2143 at most locations with organic soils, but comparable or significantly higher KS/T yields than CP 78-1628 at each location with sand soils (tables 3 and 4).

CP 99-2099 yielded significantly more TS/H and TC/H than CP 78-1628 at Hilliard and Lykes, the two locations with sand soils (tables 2 and 5). On organic soils, CP 99-2099 yielded significantly more TS/H than CP 89-2143 at three of seven locations (Knight, Wedgworth, and Osceola) and significantly more TC/H than CP 89-2143 at four of seven locations. The mean harvest KS/T yields of CP 99-2099 and CP 72-2086 were similar, as were the harvest KS/T yields of CP 99-2099 and CP 78-1628 on sand soils; but the KS/T yields of CP 99-2099 were significantly lower than those of CP 89-2143 at six of seven locations with organic soils (table 4).

CP 99-1893, CP 99-1534, CP 99-1894, and CP 99-1686 generally had TS/H yields similar to those of CP 89-2143 at the seven locations with organic soils and similar to those of CP 78-1628 at the two locations with sand soils (table 5). The harvest KS/T yield of CP 99-1893 was significantly less than that of CP 89-2143 at each location with organic soils, similar to that of CP 78-1628 at Hilliard (sand soil), and significantly higher than that of CP 78-1628 at Lykes (sand soil) (table 4). The harvest KS/T yield of CP 99-1534 was significantly lower than that of CP 89-2143 at five of seven locations with organic soils, similar to that of CP 78-1628 at Hilliard, and significantly higher than that of CP 78-1628 at Lykes. The harvest KS/T yields of CP 99-1894 were significantly less than those of CP 89-2143 at six of seven locations with organic soils, similar to the KS/T yield of CP 78-1628 at Hilliard, and significantly higher than the KS/T yield of CP 78-1628 at Lykes. The harvest KS/T yield of CP 99-1686 was significantly less than that of CP 89-2143 at six of seven locations with organic soils, and similar to that of CP 78-1628 at each location with sand soils.

CP 99-2084 yielded significantly more TC/H, preharvest KS/T, and TS/H than CP 78-1628 on the sand soil at Lykes (tables 2, 3, and 5). The TS/H yields of CP 78-1628 and CP 99-2084 were similar on the sand soil at Hilliard.

The Florida Sugarcane League has begun increasing vegetative planting material of CP 99-1534, CP 99-1893, CP 99-1894, CP 99-2084, and CP 99-2099 for potential release. CP 99-1534 and CP 99-1894 had reactions acceptable for commercial production to smut, rust, leaf scald, mosaic, and ratoon stunting (table 1). CP 99-1893 had acceptable reactions to all of these diseases except ratoon stunting, CP 99-2084 had acceptable reactions to all except mosaic, and CP 99-2099 had acceptable reactions to all except rust. All of these CP 99 clones had between 9 and 10 percent fiber except CP 99-1894, which had 11.14 percent fiber. CP 99-1893, CP 99-1894, CP 99-2084, and CP 99-2099 had moderate cold tolerance, and CP 99-1534 had poor cold tolerance (table 18).

Plant-Cane Crop, CP 98 Series

Last year's report contained the results from six locations of the CP 98 series plant-cane crop. Based on yields reported last year, plantings of CP 98-1118, CP 98-1029, CP 98-1335, and CP 98-1497 are being expanded for potential commercial release (Glaz et al. 2005). This year, results are available from two additional locations (tables 6 and 7). No new CP 98 clone yielded significantly more TS/H or harvest or preharvest KS/T than CP 72-2086 or CP 89-2143 (tables 6 and 7).

CP 98-1118 had mean KS/T and TS/H yields across both locations similar to those of CP 89-2143 and CP 72-2086. Its mean TC/H yield was also similar to that of CP 89-2143, but significantly higher than that of CP 72-2086 (table 7). CP 98-1118 also had a parent, US 87-1006, that descended from *Saccharum spontaneum* clone SES 196. SES 196 was used as a parent because of its cold tolerance.

CP 98-1029, CP 98-1497, CP 89-2143, and CP 72-2086 had similar KS/T, TC/H, and TS/H yields (tables 6 and 7). CP 98-1335 also had KS/T, TC/H, and TS/H yields similar to those of CP 89-2143 and CP 72-2086. However, in general, these yields were substantially, but not significantly, lower than those of CP 98-1118 and CP 98-1029.

Of the CP 98 clones that advanced to the Florida Sugar Cane League increase program, CP 98-1335 and CP 98-1497 had reactions acceptable for commercial production to smut, rust, leaf scald, mosaic, and ratoon stunting (table 1). CP 98-1029 had acceptable reactions to all diseases except mosaic and ratoon stunting. All three of these CP 98 clones were between 9 and 10 percent fiber. Freeze tolerance was excellent for CP 98-1029 and poor for CP 98-1335 and CP 98-1497 (table 18). CP 98-1118 is no longer in the Florida Sugar Cane League expansion program because of its susceptibility to mosaic (table 1).

First-Ratoon Crop, CP 98 Series

When averaged across all six farms, two of the new clones being expanded by the Florida Sugar Cane League—CP 98-1029 and CP 98-1335—yielded significantly more TC/H and TS/H than CP 72-2086 (tables 8 and 10). Both new clones and CP 72-2086 had similar KS/T yields (table 9). CP 98-1118 and CP 98-1497, also identified as high-yielding clones last year (Glaz et al. 2005), had TS/H yields that were low but similar to those of CP 72-2086 (table 10). One cause of the low mean yield of CP 98-1118 was its extremely low TS/H yield at Knight, probably because of its poor emergence there due to flooding after planting.

CP 98-1725 and CP 98-1569 had mediocre yields as plant cane last year (Glaz et al. 2005). This year, TC/H and TS/H yields of CP 98-1725 were significantly higher than those of CP 72-2086 (tables 8 and 10). The KS/T yield of CP 98-1725 was similar to that of CP 72-2086 (table 9). The TS/H yields of CP 98-1725 were unstable, due mostly to a low TS/H yield at Duda (table 10). The KS/T yield of CP 98-1569 was significantly higher than that of CP 72-2086 (table 9), and the TC/H yields of CP 98-1569 and CP 72-2086 were similar (table 8). CP 98-1325 also had significantly higher TC/H and TS/H yields than those of CP 72-2086 (tables 8 and 10). However, the KS/T yield of CP 98-1325 was significantly lower than that of CP 72-2086 (table 9).

The Florida Sugar Cane League is now in its second year of expanding plantings for potential release of CP 98-1029, CP 98-1335, and CP 98-1497 (table 1). The disease susceptibilities, fiber percentage, and cold tolerance of each of these clones were discussed in the "Plant-Cane Crop, CP 98 Series" section.

First-Ratoon Crop, CP 97 Series

When averaged across all four farms, no new clone yielded significantly more TS/H or TC/H than CP 70-1133 (table 11). Two clones—CP 97-1994 and CP 97-1944, both with TS/H yields similar to the TS/H yield of CP 70-1133—had significantly higher yields of KS/T than CP 70-1133 (tables 11 and 12). Two years ago as plant cane and last year as first ratoon, seven new clones—CP 97-1164, CP 97-1387, CP 97-1777, CP 97-1944, CP 97-1979, CP 97-1989, and CP 97-1994—yielded significantly more TS/H than CP 70-1133 (Glaz et al. 2003 and Glaz et al. 2005).

Of these seven new clones, CP 97-1944 and CP 97-1989 were released for commercial production in Florida (table 1). CP 97-1989, which was released for high yields on sand soils, had high TS/H yield at Hilliard, but not significantly higher than CP 70-1133 (table 11). CP 97-1777 and CP 97-1994 had acceptable yields, but were not released because of late-developing susceptibilities to rust (CP 97-1994) and mosaic (CP 97-1777) (table 1).

CP 97-1944 and CP 97-1989 had reactions acceptable for commercial production to smut, rust, mosaic, and ratoon stunting, but both clones were susceptible to leaf scald (table 1). Fiber was 10.86 percent in CP 97-1944 and 12.05 percent in CP 97-1989. CP 97-1944 and CP 97-1989 ranked first and sixth, respectively, for cold tolerance (table 18). Lower rankings mean better cold tolerance.

Second-Ratoon Crop, CP 97 Series

When averaged across all seven locations, CP 97-1994 and CP 97-1944 yielded significantly more TC/H, KS/T, and TS/H than CP 70-1133 (tables 13-15). Also, CP 97-1979 yielded significantly more TC/H and TS/H, but significantly less KS/T, than CP 70-1133. Both CP 97-1994 and CP 97-1979 had high and stable TC/H, KS/T, and TS/H yields across locations, with the exception that KS/T yields of CP 97-1979 were stable and low across locations. Yields of CP 97-1944 were moderately stable across locations with the notable exception that its KS/T yield was significantly and substantially higher than that of any other clones on the sand soil at Lykes (table 14).

Of these CP 97 series clones, CP 97-1944 was released for commercial production and recommended for all sugarcane soil types in Florida and CP 97-1989 was released for commercial production and recommended for sand soils in Florida (table 1). CP 97-1989 had high TS/H yield, but not significantly higher than that of CP 70-1133, at Lykes (table 15). However, the TC/H yield of CP 97-1989 was significantly and substantially higher than that of CP 70-1133 at Lykes (table 13), and the KS/T of CP 97-1989 was significantly and substantially lower than that of CP 70-1133 at Lykes (table 14).

The disease susceptibilities, fiber percentage, and cold tolerance of CP 97-1944 and CP 97-1989 were discussed above in “First-Ratoon Crop, CP 97 Series.”

Second-Ratoon Crop, CP 96 Series

Mean yields of TS/H across all three farms were significantly higher for CP 96-1171 and CP 96-1602 than for CP 70-1133; CP 96-1171 also yielded significantly more TC/H than CP 70-1133 (table 16). CP 96-1252 almost yielded significantly more TS/H than CP 70-1133 (table 16). CP 96-1602, CP 96-1171, and CP 96-1252 yielded significantly more KS/T than CP 70-1133 (table 17). CP 96-1252 and CP 96-1602 have both been released for commercial production in Florida. Both of these clones had high yields all years they were tested in stage IV experiments (Glaz et al. 2001, Glaz et al. 2002b, Glaz et al. 2004).

CP 96-1252 and CP 96-1602 ranked seventh and eleventh, respectively, for cold tolerance in a group of 13 clones (table 18). CP 70-1133 and CP 72-2086 ranked third and ninth. CP 96-1602’s fiber was 9.58 percent, and though it was not too susceptible to any disease for commercial production, it had a low level of susceptibility to each major sugarcane disease in Florida: smut, rust, leaf scald, mosaic, and ratoon stunting (table 1). CP 96-1252 had 9.42 percent fiber, and it has become too susceptible to rust for commercial production in Florida since its release.

Summary

The CP 99 series was tested for the first time this year at nine locations in stage IV. CP 99-1534, CP 99-1686, CP 99-1893, CP 99-1894, and CP 99-2099 had high TS/H and TC/H yields. Each of these new clones had low preharvest and harvest KS/T yields on organic soils, but acceptable or high KS/T yields on sand soils.

The CP 98 series was tested at two locations in the plant-cane crop and six locations in the first-ratoon crop this year and at six locations in the plant-cane crop last year. Vegetative planting material of CP 98-1029, CP 98-1335, and CP 98-1497 is being expanded by the Florida Sugar Cane League for potential release in Florida. These three clones and CP 98-1118 had high 2-year mean TS/H and KS/T yields. However, CP 98-1118 is too susceptible to mosaic for commercial production in Florida. CP 98-1325 also had high TS/H yields but low yields of KS/T.

The CP 97 series was tested at four locations in the first-ratoon crop and seven locations in the second-ratoon crop this year, at four locations in the plant-cane

crop and seven locations in the first-ratoon crop last year, and at seven locations in the plant-cane crop two years ago. CP 97-1944 and CP 97-1989 have both been recommended for release for commercial production in Florida. Averaged across all crops and years, CP 97-1944, CP 97-1777, and CP 97-1994 had high yields of TS/H, TC/H, and KS/T. CP 97-1777 and CP 97-1994 were not released because of susceptibility to rust. CP 97-1989 had high yields of TS/H and TC/H on all soils, but its KS/T yields were acceptably high for commercial production only on sand soils. CP 97-1164, CP 97-1387, and CP 97-1979 also had high yields of TS/H.

Stage IV testing of the CP 96 series was completed this year with second-ratoon experiments at 4 locations. Previous testing of these clones included two years and 9 locations as plant cane, two years and 11 locations as first ratoon, and 6 locations as second ratoon last year. CP 96-1252 and CP 96-1602 have both been released for commercial production in Florida. Mean TC/H, KS/T, and TS/H yields across all plant-cane through second-ratoon tests that included these cultivars were 158.89*, 122.9**, and 19.466***, respectively for CP 96-1252; 148.39, 126.6**, and 18.837*, respectively for CP 96-1602; and 143.95, 117.9, and 16.884, respectively for CP 70-1133.

* Significantly higher than CP 70-1133 at the 5 percent probability level.
** Significantly higher than CP 70-1133 at the 1 percent probability level.
*** Significantly higher than CP 70-1133 at the 0.1 percent probability level.

References

Comstock, J.C., J.M. Shine Jr., P.Y.P. Tai, and J.D. Miller. 2001. Breeding for ratoon stunting disease resistance: Is it both possible and effective? *In* International Society of Sugar Cane Technologists: Proceedings of the XXIV Congress, 17-21 September 2001, Brisbane, Australia, vol 2, pp. 471-476. The Society, Brisbane, Australia.

Deren, C.W. 1995. Genetic base of U.S. mainland sugarcane. Crop Science 35:1195-1199.

Deren, C.W., J. Alvarez, and B. Glaz. 1995. Use of economic criteria for selecting clones in a sugarcane breeding program. Proceedings of the International Society of Sugar Cane Technologists 21:2, 437-447.

Glaz, B., J. Alvarez, and J.D. Miller. 1986. Analysis of cultivar-use options with sugarcane as influenced by threats of new pests. Agronomy Journal 78:503-506.

Glaz, B., J.C. Comstock, et al. 2001. Evaluation of new Canal Point sugarcane clones: 1999-2000 harvest season. U.S. Department of Agriculture, Agricultural Research Service, ARS-157.

Glaz, B., J.C. Comstock, et al. 2004. Evaluation of new Canal Point sugarcane clones: 2001-2002 harvest season. U.S. Department of Agriculture, Agricultural Research Service, ARS-161.

Glaz, B., and J.L. Dean. 1988. Statistical error rates and their implications in sugarcane clone trials. Agronomy Journal 80:560-562.

Glaz, B., J.D. Miller, et al. 2002a. Sugarcane genotype repeatability in replicated selection stages and commercial adoption. Journal American Society of Sugar Cane Technologists 22:73-88.

Glaz, B., P.Y.P. Tai, et al. 2002b. Evaluation of new Canal Point sugarcane clones: 2000-2001 harvest season. U.S. Department of Agriculture, Agricultural Research Service, ARS-159.

Glaz, B., P.Y.P. Tai, et al. 2005. Evaluation of new Canal Point sugarcane clones: 2002-2003 harvest season. U.S. Department of Agriculture, Agricultural Research Service, ARS-164.

Glaz, B., and J. Vonderwell. 2004. Sugarcane variety census: Florida 2003. Sugar Journal 67(2):11-19.

Legendre, B.L. 1992. The core/press method for predicting the sugar yield from cane for use in cane payment. Sugar Journal 54(9):2-7.

Lockhart, B.E.L., M.J. Irey, and J.C. Comstock. 1996. Sugarcane bacilliform virus, sugarcane mild mosaic virus and sugarcane yellow leaf syndrome. *In* B.J. Croft, C.M. Piggin, E.S. Wallis, and D.M. Hogarth, eds., Sugarcane Germplasm Conservation and Exchange, pp. 108-112. Australian Centre for International Agricultural Research, Canberra, Australia, Proceedings No. 67.

Rice, R.W., R.A. Gilbert, and S.H. Daroub. 2002. Application of the soil taxonomy key to the organic soils of the Everglades Agricultural Area. Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, SS-AGR-246. Available online at http://edis.ifas.ufl.edu/AG151 (May 2002, verified Sept. 9, 2002).

Shukla, G.K. 1972. Some statistical aspects of partitioning genotype-environmental components of variability. Heredity 29:237-245.

Sosa, O., Jr. 1996. Breeding for leaf pubescence in sugarcane to control borers. Abstract. Sugar y Azucar 91(6):30

Tai, P.Y.P., and J.D. Miller. 1996. Selection for frost resistance in sugarcane. Sugar Cane 1996(3):13-18.

White, W.H., J.D. Miller, et al. 2001. Inheritance of sugarcane borer resistance in sugarcane derived from two measures of insect damage. Crop Science 41:1706-1710.

Tables

Notes (tables 2-17):

1. Clonal yields approximated by least squares ($p = 0.10$) within locations.
2. Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
3. Yields for locations and across locations approximated by empirical best linear unbiased predictors.
4. *LSD* = ratoon stunting disease.
5. *CV* = coefficient of variation.

Table 1. Parentage, fiber content, and ratings of susceptibility to smut, rust, leaf scald, mosaic, and ratoon stunting disease for CP 70-1133, CP 72-2086, CP 78-1628, CP 89-2143 and 50 new sugarcane clones

			Rating*				
Clone	Parentage	Percent fiber	Smut	Rust	Leaf Scald	Mosaic	Ratoon stunting
CP 70-1133†	67 P 6 CP 56-63‡	10.37	L	S	L	R	S
CP 72-2086†	CP 62-374 × CP 63-588	8.97	R	R	R	S	R
CP 78-1628†	CP 65-0357 × CP 68-1026	10.39	S	S	L	R	R
CP 89-2143†	CP 81-1254 × CP 72-2086	9.85	R	R	L	L	L
CP 96-1161	CP 75-1091 × CP 78-1628	10.54	L	S	R	L	R
CP 96-1171	CP 83-1770 × CP 80-1827	8.58	S	L	L	L	L
CP 96-1252†	CP 90-1533 × CP 84-1198	9.42	R	L	L	R	R
CP 96-1253	CP 90-1533 × CP 84-1198	8.91	R	R	L	L	L
CP 96-1288	TCP 90-4094 × TCP 90-4121	9.20	S	R	L	S	R
CP 96-1290	TCP 90-4094 × TCP 90-4121	9.48	S	R	L	R	R
CP 96-1300	CP 89-2376 × CP 72-1210	10.71	S	L	S	L	S
CP 96-1350	CP 89-1717 × CP 85-1432	8.78	L	L	L	R	R
CP 96-1602†	CP 81-1425 × 94 P 03	9.58	L	L	L	L	L
CP 96-1686	CP 85-1382 × 94 P 05	10.44	R	R	L	R	R
CP 96-1865	Green German × CP 70-1133	12.60	L	S	R	L	S
CP 97-1068	CP 90-1204 × CP 90-1151	11.17	L	R	L	L	S
CP 97-1164	CP 93-1621 × 94 P 03	9.17	R	R	L	R	S
CP 97-1362	CP 91-2234 × CL 72-0321	9.96	L	L	L	R	R
CP 97-1387	CP 90-1533 × CL 61-0620	10.36	L	R	L	L	L
CP 97-1433	CP 90-1497 × 94 P 13	11.87	L	R	S	R	R
CP 97-1777	CP 90-1233 × CP 57-0603	10.01	S	L	L	S	L
CP 97-1804	CP 90-1424 × CP 89-2377	12.19	R	S	S	L	L
CP 97-1850	CP 89-2377 × 94 P 17	10.56	S	R	L	R	L
CP 97-1928	CP 90-1533 × CP 57-0603	11.32	L	R	S	L	R
CP 97-1944†	CP 80-1743 × 94 P 15	10.86	R	R	S	L	L
CP 97-1979	CP 75-1091 × CL 61-0620	11.78	R	L	L	L	R
CP 97-1989†	CP 75-1091 × CL 61-0620	12.05	R	L	S	L	L
CP 97-1994	CP 89-1945 × CP 70-1133	10.51	L	L	L	R	R
CP 97-2068	CP 90-1204 × CP 90-1436	12.01	S	L	R	L	R
CP 97-2103	ROC 12 × 95 P 14	13.80	U	R	L	R	L
CP 98-1029§	CP 91-1980 × CP 94-1952	9.91	R	R	L	S	S
CP 98-1107	HoCP 85-845 × CP 80-1827	9.73	L	L	S	L	R

CP 98-1118	CL 61-0620 × US 87-1006	9.03	R	L	R	S	L
CP 98-1139	CP 90-1151 × HoCP 85-845	8.86	R	R	L	R	R
CP 98-1325	CP 90-1030 × 95 P 08	8.02	R	S	R	L	L
CP 98-1335§	TCP 87-3388 × CP 70-1133	9.07	R	R	R	R	L
CP 98-1417	HoCP 85-845 × CP 80-1827	9.53	R	L	L	L	L
CP 98-1457	CP 89-2377 × CP 90-1151	9.11	R	R	R	L	S
CP 98-1481	HoCP 85-845 × CP 88-1836	10.05	R	R	L	R	L
CP 98-1497§	CP 91-1238 × CP 87-1628	9.37	R	R	R	L	L
CP 98-1513	CP 90-1424 × CP 87-1628	11.92	R	R	L	S	L
CP 98-1569	CP 80-1827 × 95 P 08	9.91	L	R	R	S	L
CP 98-1725	CP 89-2377 × CP 89-1756	8.33	R	R	R	L	S
CP 98-2047	CP 87-1475 × self	11.08	R	R	L	L	L
CP 99-1534§	CP 89-2377 × CP 89-1756	9.20	R	R	L	L	L
CP 99-1540	CP 90-1535 × 95 P 16	11.28	L	S	R	L	R
CP 99-1541	CP 90-1535 × 95 P 16	8.58	R	R	R	R	R
CP 99-1542	CP 90-1535 × 95 P 16	11.54	R	R	L	L	L
CP 99-1686	CP 85-1382 × CP 70-1133	10.25	L	L	L	R	R
CP 99-1865	CP 91-1795 × CP 90-1151	9.37	L	R	L	R	R
CP 99-1889	CP 87-1475 × CP 72-1210	12.75	S	S	L	R	L
CP 99-1893§	CP 87-1475 × CP 72-1210	9.94	R	L	L	R	S
CP 99-1894§	CP 87-1475 × CP 72-1210	11.14	R	R	L	R	L
CP 99-1896	CP 90-1204 × CP 90-1436	10.56	R	R	R	L	S
CP 99-1944	LCP 86-454 × self	10.43	L	S	L	L	R
CP 99-2084§	CP 93-1634 × CP 84-1198	10.94	R	R	L	S	R
CP 99-2099§	CP 89-2377 × CP 84-1198	10.17	L	S	L	L	R
CP 99-3027	Unknown	11.07	R	S	R	R	L

* R = resistant enough for commercial production; L = low levels of disease susceptibility; S = too susceptible for production; U = undetermined susceptibility (available data not sufficient to determine the level of susceptibility).

† Released for commercial production in Florida.

‡ 67 P 6 = 6th polycross made in 1967 crossing season. Female parent (CP 56-63) exposed to pollen from many clones; therefore, male parent of CP 70-1133 unknown. Similar explanations for CP 96-1602, CP 96-1686, CP 97-1164, CP 97-1433, CP 97-1850, CP 97-1944, CP 97-2103, CP 98-1325, CP 98-1569, CP 99-1540, CP 99-1541, CP 99-1542.

§ Vegetative planting material currently being increased by Florida Sugar Cane League, Inc., for potential release.

Table 2. Yields of cane in metric tons per hectare (TC/H) from plant cane on Dania muck, Lauderhill muck, Terra Ceia muck, Malabar sand, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*										
	Dania muck	Lauderhill muck				Terra Ceia muck		Malabar sand	Pompano fine sand		
Clone	Duda 1/24/04	Knight 1/13/04	SFI 1/20/04	Wedgworth 1/26/04	Okeelanta 2/7/04	Osceola 1/27/04	USSC 2/18/04	Hilliard 12/8/03	Lykes 12/9/03	Stability	Estimated yield, all farms†
CP 99-2099	163.52	200.20	204.54	238.94	188.26	188.05	154.09	196.91	165.82	2852.65	196.47
CP 99-1893	173.55	148.20	246.22	208.94	168.94	199.59	159.76	170.46	150.45	1225.74	189.57
CP 99-1896	131.22	154.19	238.00	221.78	202.26	228.38	175.98	184.96	159.71	5589.34	186.08
CP 99-1894	166.17	179.22	227.90	202.80	158.38	166.37	119.46	170.49	136.90	1543.94	173.83
CP 99-1686	169.29	174.82	243.55	187.03	186.87	162.72	157.77	149.34	122.56	1039.40	172.46
CP 99-1889	164.13	192.87	247.97	220.08	165.15	155.06	138.69	163.59	143.56	2514.31	172.20
CP 99-1534	147.38	174.15	273.56	190.36	157.57	186.86	162.25	159.14	125.82	3367.19	170.93
CP 99-2084	164.66	144.51	208.82	206.56	183.38	207.78	106.49	156.52	158.10	4600.74	165.70
CP 99-1865	145.63	181.00	187.58	210.32	159.97	141.13	164.45	144.67	140.83	3080.70	164.09
CP 78-1628	–	–	–	–	–	–	–	162.05	132.40	69.44	158.94
CP 89-2143	152.30	139.22	218.84	173.87	161.29	141.42	142.49	–	–	708.90	157.80
CP 99-3027	179.27	152.43	210.00	175.38	140.46	137.94	151.84	132.25	125.56	1830.84	155.89
CP 99-1944	174.73	171.26	185.11	180.84	150.65	177.87	157.98	122.29	102.02	1900.88	154.57
CP 72-2086	147.25	133.34	180.94	173.94	144.89	155.45	148.71	152.26	105.38	738.61	149.48
CP 99-1540	160.39	122.58	190.18	166.09	125.56	119.23	119.71	160.87	106.93	1548.12	143.10
CP 99-1541	135.24	118.65	177.51	146.09	126.90	137.76	133.64	123.26	111.16	656.96	133.03
CP 99-1542	111.12	106.04	166.43	116.10	109.53	143.16	116.66	119.02	99.54	1682.66	120.27
Mean‡	156.12	156.48	210.11	187.37	158.75	165.67	146.44	154.36	132.05	2055.91	163.04
LSD (p = 0.1)§	20.07	24.73	22.18	22.08	17.44	20.64	18.45	17.93	18.45		12.08
CV (%)††	7.72	9.48	6.34	7.08	6.60	7.48	7.56	6.97	8.38		7.60

* Clonal yields approximated by least squares (p = 0.10) within locations.
† Stability for each clone is calculated at p = 0.10 by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 14.43 KS/T at p = 0.10.
†† *CV* = coefficient of variation.

Table 3. Preharvest yields of theoretical recoverable 96° sugar in kg per metric ton (KS/T) from plant cane on Dania muck, Lauderhill muck, Terra Ceia muck, Malabar sand, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*										
	Dania muck	Lauderhill muck				Terra Ceia muck		Malabar sand	Pompano fine sand		
Clone	Duda 10/13/03	Knight 10/13/03	SFI 10/14/03	Wedgworth 10/20/03	Okeelanta 10/22/03	Osceola 10/20/03	USSC 11/10/03	Hilliard 10/15/03	Lykes 10/17/03	Stability†	Estimated yield, all farms
CP 99-1541	105.7	113.4	112.7	106.6	124.6	111.2	124.7	117.9	115.5	12.8	114.1
CP 78-1628	–	–	–	–	–	–	–	114.6	109.7	217.7	112.2
CP 72-2086	84.0	113.0	100.3	109.7	115.9	110.1	115.2	104.2	127.2	116.0	107.9
CP 89-2143	111.5	108.3	98.9	87.1	119.1	98.3	126.6	–	–	185.4	107.4
CP 99-1865	90.3	109.8	90.9	101.8	123.2	98.3	118.4	113.1	119.9	69.7	106.7
CP 99-1542	94.7	107.4	101.0	107.6	111.4	89.7	109.1	107.5	119.7	88.6	106.2
CP 99-1893	87.5	105.1	82.2	100.6	113.4	108.5	119.6	113.2	120.8	130.5	105.8
CP 99-1894	106.6	106.8	83.4	87.6	105.9	99.7	120.5	111.3	121.3	181.4	105.1
CP 99-1686	92.1	93.7	103.5	92.9	111.5	91.3	111.1	109.8	126.4	77.7	104.8
CP 99-3027	85.8	101.0	93.5	102.9	102.8	99.3	108.6	112.8	124.9	48.4	103.4
CP 99-2099	88.0	101.1	98.3	94.1	106.6	101.1	106.6	113.5	126.6	27.8	103.2
CP 99-1944	96.2	94.9	83.1	92.8	119.4	98.7	104.3	117.4	120.2	140.3	102.4
CP 99-1540	76.8	111.6	98.5	92.6	103.7	92.5	116.1	105.0	115.2	122.9	100.8
CP 99-1534	79.2	107.2	89.5	90.8	105.1	89.9	106.9	108.2	113.3	43.7	99.7
CP 99-1889	78.3	97.6	83.7	87.2	94.1	83.5	104.5	105.4	109.7	18.4	93.1
CP 99-2084	88.7	78.3	86.1	77.5	79.9	76.4	97.7	112.8	119.4	191.3	90.7
CP 99-1896	78.5	90.5	86.6	78.6	93.2	86.2	101.3	86.3	107.7	15.4	90.4
Mean‡	90.5	102.3	93.5	94.6	107.5	96.1	111.5	109.8	118.5	99.3	102.7
LSD ($p = 0.1$)§	15.3	8.5	13.0	14.6	17.3	8.7	9.3	20.2	9.3		3.2
CV (%)††	9.7	4.7	8.0	8.9	9.2	5.2	4.8	10.5	4.5		2.3

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of sugar yield = 4.7 KS/T at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 4. Harvest yields of theoretical recoverable 96° sugar in kg per metric ton (KS/T) from plant cane on Dania muck, Lauderhill muck, Terra Ceia muck, Malabar sand, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*										
	Dania muck	Lauderhill muck				Terra Ceia muck		Malabar sand	Pompano fine sand		
Clone	Duda 1/24/04	Knight 1/13/04	SFI 1/20/04	Wedgworth 1/26/04	Okeelanta 2/7/04	Osceola 1/27/04	USSC 2/18/04	Hilliard 12/8/03	Lykes 12/9/03	Stability†	Estimated yield all farms
CP 89-2143	129.8	124.0	132.6	130.3	129.8	136.4	141.3	–	–	76.5	131.7
CP 99-1541	124.2	125.3	119.8	125.6	126.6	131.1	134.2	132.2	138.2	54.4	128.8
CP 78-1628	–	–	–	–	–	–	–	130.6	129.9	279.3	128.0
CP 72-2086	116.1	133.0	125.8	127.6	127.0	128.5	134.8	119.9	137.2	131.2	126.6
CP 99-1534	121.8	122.5	124.9	123.3	120.6	120.9	126.7	124.3	136.8	8.3	126.4
CP 99-1542	124.4	125.2	120.0	120.5	128.8	102.7	111.5	133.8	138.5	787.6	124.0
CP 99-1893	116.5	109.0	121.1	119.3	114.5	124.0	131.4	128.7	139.3	168.2	123.2
CP 99-1894	121.3	123.5	112.4	119.3	122.3	126.3	132.9	121.4	135.8	143.7	123.0
CP 99-1686	116.0	124.6	123.0	116.7	110.1	121.3	121.6	130.1	133.8	146.7	122.5
CP 99-1865	115.1	114.4	122.8	121.5	114.2	122.7	131.7	126.8	135.9	99.2	122.3
CP 99-3027	116.7	116.7	121.4	113.0	120.0	120.9	131.3	125.3	136.4	85.4	122.3
CP 99-2099	111.7	120.7	117.3	122.6	121.8	122.9	120.3	127.8	130.5	93.1	121.4
CP 99-1944	122.8	94.4	127.1	114.8	119.0	122.6	122.2	129.6	136.7	768.9	120.6
CP 99-2084	121.0	118.8	106.5	120.5	102.3	114.2	115.6	126.9	126.0	375.8	117.2
CP 99-1540	102.5	122.5	115.6	120.6	120.0	114.9	123.3	116.1	132.0	247.0	117.1
CP 99-1889	111.0	110.3	111.5	109.2	112.5	110.3	110.9	115.0	124.7	46.6	112.3
CP 99-1896	102.5	110.4	101.4	104.6	101.7	100.1	116.1	109.7	121.4	112.2	108.2
Mean‡	117.6	118.8	119.3	119.6	118.6	120.2	125.0	125.3	132.9	213.2	121.9
LSD ($p = 0.1$)§	8.9	6.5	6.0	6.3	6.6	4.5	4.8	10.3	4.8		5.7
CV (%)††	4.6	3.3	3.0	3.2	3.4	2.2	2.3	4.9	2.2		3.2

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 3.9 KS/T at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 5. Yields of theoretical recoverable 96° sugar in metric tons per hectare (TS/H) from plant cane on Dania muck, Lauderhill muck, Terra Ceia muck, Malabar sand, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*										
	Dania muck	Lauderhill muck				Terra Ceia muck		Malabar sand	Pompano fine sand		
Clone	Duda 1/24/04	Knight 1/13/04	SFI 1/20/04	Wedgworth 1/26/04	Okeelanta 2/7/04	Osceola 1/27/04	USSC 2/18/04	Hilliard 12/8/03	Lykes 12/9/03	Stability†	Estimated yield, all farms
CP 99-2099	18.370	23.983	24.013	29.262	22.797	22.957	18.543	25.073	21.538	62.003	23.720
CP 99-1893	20.152	16.331	29.907	24.848	19.362	24.758	21.007	21.923	20.947	35.856	23.259
CP 99-1534	18.120	21.343	34.140	23.478	19.103	22.547	20.590	19.878	17.180	57.616	21.594
CP 99-1894	20.183	22.192	25.958	24.167	19.300	20.983	15.863	20.913	18.564	21.200	21.225
CP 99-1686	19.598	21.660	30.090	21.833	20.553	19.642	19.190	19.482	16.392	21.955	21.009
CP 89-2143	19.798	17.210	29.003	22.657	20.833	19.240	20.110	–	–	13.409	20.818
CP 78-1628	–	–	–	–	–	–	–	21.158	17.246	17.344	20.232
CP 99-1865	16.787	20.703	23.102	25.737	18.343	17.328	21.673	18.372	19.143	44.260	20.053
CP 99-1896	13.553	17.025	24.087	23.125	20.494	22.875	20.407	20.314	19.412	47.950	19.896
CP 99-2084	19.852	16.968	22.485	24.817	18.752	23.595	12.310	19.906	19.893	73.623	19.437
CP 99-1889	18.240	21.292	27.670	24.150	18.617	17.100	15.343	18.882	17.882	33.755	19.384
CP 99-3027	20.937	17.735	25.463	19.797	16.852	16.680	19.840	16.592	17.135	30.123	18.948
CP 72-2086	17.140	17.445	22.738	22.180	18.407	19.968	20.037	18.050	14.530	10.613	18.764
CP 99-1944	21.492	16.167	23.508	20.742	17.868	21.778	19.347	15.862	13.877	29.399	18.545
CP 99-1541	16.743	14.868	21.252	18.430	16.067	18.053	17.993	16.277	15.352	12.592	16.930
CP 99-1540	16.317	14.995	21.985	20.055	15.123	13.682	14.773	18.725	14.127	9.592	16.661
CP 99-1542	13.925	13.026	20.053	13.910	14.125	14.758	13.007	15.945	13.838	11.814	14.899
Mean‡	18.367	18.458	24.961	22.290	18.681	19.795	18.363	19.311	17.578	31.359	19.756
LSD ($p = 0.1$)§	2.683	3.162	3.305	3.209	2.181	2.294	2.565	2.719	2.565		1.405
CV (%)††	8.771	10.277	7.948	8.645	7.012	6.956	8.381	8.451	8.755		7.008

* Clonal yields approximated by least squares ($p = 0.10$) within locations.

† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.

‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.

§ *LSD* for location means of cane yield = 1.679 KS/T at $p = 0.10$.

†† *CV* = coefficient of variation.

Table 6. Yields of preharvest and harvest theoretical recoverable 96° sugar in kg per metric ton (KS/T) from plant cane on Pahokee muck and Torry muck

	Preharvest yield by soil type, farm, and sampling date*			Harvest yield by soil type, farm, and sampling date*		
	Pahokee muck	Torry muck		Pahokee muck	Torry muck	
Clone	Okeelanta 10/22/03	Eastgate 10/21/03	Estimated yield, both farms†	Okeelanta 12/2/03	Eastgate 2/28/04	Estimated yield, both farms†
CP 98-1569	134.2	132.1	131.5	134.7	132.4	133.9
CP 89-2143	129.4	125.8	123.3	132.1	133.9	131.1
CP 72-2086	121.7	125.9	125.9	127.0	128.4	127.4
CP 98-1118	118.8	124.5	121.5	123.6	123.9	126.8
CP 98-1029	117.6	105.8	114.7	130.2	118.4	126.5
CP 98-1497	127.5	119.3	124.1	132.1	127.9	125.4
CP 98-1725	122.1	119.9	121.2	127.9	119.8	125.4
CP 98-1457	109.7	106.8	112.5	113.1	128.3	122.6
CP 98-1139	117.5	117.7	119.2	115.4	129.5	122.2
CP 98-1335	116.2	110.6	109.1	121.4	121.8	120.8
CP 98-1417	120.9	110.9	113.7	115.3	118.8	117.3
CP 98-1513	111.2	100.3	105.9	120.2	119.4	116.7
CP 98-2047	113.0	77.8	99.7	110.3	119.0	115.4
CP 98-1325	104.7	94.4	99.3	102.8	128.3	113.8
CP 98-1481	114.9	120.8	114.8	111.9	119.0	113.3
CP 98-1107	116.9	91.4	103.5	104.6	111.9	112.9
Mean	118.0	112.0	115.0	120.9	123.0	122.0
LSD ($p = 0.1$)‡	7.1	13.4	11.1	4.2	6.8	10.7
CV (%)§	3.5	6.9	6.7	2.1	3.3	5.4

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Yields for locations and across locations approximated by empirical best linear unbiased predictors.
‡ *LSD* for location means of preharvest sugar yield = 4.8 KS/T and of harvest yield = 4.1 KS/T at $p = 0.10$.
§ *CV* = coefficient of variation.

Table 7. Yields of cane and of theoretical recoverable 96° sugar in metric tons per hectare (TC/H and TS/H) from plant cane on Pahokee muck and Torry muck

Clone	Cane yield by soil type, farm, and sampling date*			Sugar yield by soil type, farm, and sampling date*		
	Pahokee muck	Torry muck		Pahokee muck	Torry muck	
	Okeelanta 12/2/03	Eastgate 2/28/04	Estimated yield, both farms†	Okeelanta 12/2/03	Eastgate 2/28/04	Estimated yield, both farms†
CP 98-1118	103.85	257.21	195.14	12.881	31.911	24.429
CP 98-1029	127.33	196.60	178.26	16.549	23.268	22.385
CP 98-2047	130.02	200.36	176.84	14.482	23.895	21.031
CP 98-1325	103.41	241.97	173.07	10.704	31.083	20.916
CP 98-1139	98.89	249.54	167.37	11.421	32.242	20.762
CP 89-2143	101.88	248.29	160.01	13.495	33.165	20.755
CP 98-1497	115.86	205.23	162.71	15.312	26.172	20.564
CP 98-1457	70.91	217.49	159.27	7.988	27.889	20.513
CP 72-2086	94.98	199.67	153.47	12.060	25.639	19.953
CP 98-1417	104.65	253.27	172.81	12.090	29.910	19.896
CP 98-1569	66.35	206.97	143.50	8.935	27.453	19.263
CP 98-1335	135.46	205.47	158.81	16.456	24.994	18.882
CP 98-1107	119.46	190.76	152.94	12.505	21.344	17.102
CP 98-1725	96.14	184.20	139.43	12.302	21.966	17.050
CP 98-1513	114.31	196.66	140.88	13.707	23.531	16.585
CP 98-1481	111.28	205.36	142.02	12.464	24.404	15.958
Mean	106.35	215.72	161.03	12.778	26.728	19.753
LSD ($p = 0.1$)‡	16.38	35.48	37.32	2.129	4.484	5.796
CV (%)§	9.24	9.87	15.09	10.002	10.072	18.353

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Yields for locations and across locations approximated by empirical best linear unbiased predictors.
‡ *LSD* for location means of preharvest sugar yield = 4.8 KS/T and of harvest yield = 4.1 KS/T at $p = 0.10$.
§ *CV* = coefficient of variation.

Table 8. Yields of cane in metric tons per hectare (TC/H) from first-ratoon cane on Dania muck, Lauderhill muck, Terra Ceia muck, and Pompano fine sand

	Mean yield by soil type, farm and date*							
	Dania muck			Lauderhill muck	Terra Ceia muck	Pompano fine sand		
Clone	Osceola 12/14/03	Okeelanta 12/20/03	Duda 1/21/04	SFI 11/24/03	Knight 10/26/03	Lykes 10/29/03	Stability†	Estimated yield, all farms
CP 98-1029	172.71	152.16	142.28	172.76	110.09	109.88	121.29	145.43
CP 98-1325	152.79	143.90	135.64	177.00	99.23	114.78	325.40	137.99
CP 98-1481	165.82	144.52	113.96	185.27	106.58	107.19	1241.20	136.42
CP 98-1335	157.62	138.92	131.76	151.95	127.08	105.63	1008.51	134.18
CP 98-2047	168.60	156.24	138.53	135.73	90.82	110.28	1361.42	134.06
CP 98-1725	161.50	139.17	105.41	177.03	103.72	106.39	1282.22	133.73
CP 70-1133	153.89	144.15	137.61	158.60	96.44	100.89	96.04	133.33
CP 98-1107	155.13	149.63	122.99	157.56	101.32	110.49	47.58	132.08
CP 98-1139	132.97	137.08	123.85	153.68	96.68	102.12	262.65	123.93
CP 98-1513	166.04	124.11	116.87	135.48	78.78	116.65	1627.61	123.63
CP 98-1569	132.57	133.71	150.41	145.43	93.59	74.82	2186.30	122.70
CP 98-1118	137.98	139.83	135.93	156.98	56.60	97.07	1988.45	120.23
CP 98-1497	128.99	139.95	117.11	155.63	97.59	84.29	677.23	119.24
CP 98-1457	151.76	140.08	99.38	153.96	75.18	96.94	848.80	118.85
CP 72-2086	136.67	136.49	110.07	122.60	105.81	109.87	1642.27	117.82
CP 98-1417	132.48	117.52	117.24	133.90	85.81	97.56	298.31	115.40
Mean‡	149.31	139.23	125.10	153.22	97.04	104.49	938.45	128.06
LSD ($p = 0.1$)§	21.68	17.72	22.10	20.33	28.24	13.32		8.21
CV (%)††	8.72	7.64	10.62	7.97	17.48	7.65		5.59

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 13.41 TC/H at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 9. Yields of theoretical recoverable 96° sugar in kg per metric ton (KS/T) from first-ratoon cane on Dania muck, Lauderhill muck, Terra Ceia muck, and Pompano fine sand

	Mean yield by soil type, farm and date*							
	Dania muck			Lauderhill muck	Terra Ceia muck	Pompano fine sand		
Clone	Osceola 12/14/03	Okeelanta 12/20/03	Duda 1/21/04	SFI 11/24/03	Knight 10/26/03	Lykes 10/29/03	Stability†	Estimated yield, all farms
CP 98-1569	138.4	136.9	114.8	136.8	116.6	128.0	417.3	130.4
CP 98-1497	129.8	142.4	125.0	130.4	112.8	119.3	114.6	125.6
CP 72-2086	123.7	133.3	109.2	125.4	112.1	128.7	346.0	123.9
CP 98-1029	123.9	123.7	126.8	127.9	108.1	119.2	162.7	121.3
CP 98-1725	131.2	129.9	118.9	131.1	99.4	120.7	188.6	121.2
CP 98-1335	122.6	128.5	133.4	118.9	104.4	117.0	261.5	120.1
CP 70-1133	115.7	131.5	123.7	120.6	106.1	117.6	83.0	118.8
CP 98-1457	117.8	123.4	124.3	120.7	103.4	117.8	91.2	118.7
CP 98-1139	117.9	133.5	115.5	125.2	102.0	120.5	59.0	118.6
CP 98-1118	120.0	125.7	121.0	120.8	96.2	119.0	44.7	118.0
CP 98-1417	117.3	130.2	117.9	118.0	100.7	119.7	14.9	117.8
CP 98-1325	112.3	131.2	121.0	114.4	86.4	118.4	327.2	114.6
CP 98-1481	116.2	127.0	108.2	122.9	100.3	120.4	132.2	114.3
CP 98-1513	114.9	124.5	114.6	113.0	96.9	119.1	46.8	114.0
CP 98-2047	119.4	119.7	116.3	106.3	97.2	105.2	218.5	111.4
CP 98-1107	111.5	129.7	112.1	112.0	90.1	108.3	118.2	108.3
Mean‡	120.7	129.1	118.9	121.5	102.5	118.7	164.1	118.6
LSD ($p = 0.1$)§	4.9	7.6	5.5	4.9	7.3	7.9		4.3
CV (%)††	2.4	3.5	2.8	2.4	4.3	4.0		2.5

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 3.4 KS/T at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 10. Yields of theoretical recoverable 96° sugar in metric tons per hectare (TS/H) from first-ratoon cane on Dania muck, Lauderhill muck, Terra Ceia muck, and Pompano fine sand

	Mean yield by soil type, farm and date*							
	Dania muck			Lauderhill muck	Terra Ceia muck	Pompano fine sand		
Clone	Osceola 12/14/03	Okeelanta 12/20/03	Duda 1/21/04	SFI 11/24/03	Knight 10/26/03	Lykes 10/29/03	Stability†	Estimated yield, all farms
CP 98-1029	21.525	18.772	18.027	22.032	12.073	13.118	8.827	17.811
CP 98-1725	21.169	18.012	12.476	23.179	10.463	12.895	37.434	16.466
CP 98-1335	19.318	17.833	17.501	18.103	13.286	12.384	18.022	16.102
CP 98-1325	17.103	18.926	16.418	20.225	8.759	13.643	9.087	16.042
CP 98-1569	18.301	18.198	17.253	19.920	11.030	9.688	17.750	16.025
CP 70-1133	17.727	18.850	16.997	19.144	10.293	11.966	4.407	16.013
CP 98-1481	19.287	18.310	12.255	22.786	10.678	12.927	28.850	15.723
CP 98-2047	20.137	18.771	16.101	14.534	8.780	11.538	33.538	15.219
CP 98-1497	16.703	19.957	14.698	20.299	11.207	10.085	17.960	15.147
CP 98-1139	15.590	18.482	14.314	19.275	9.951	12.349	7.504	14.900
CP 72-2086	16.940	18.210	12.072	15.392	11.924	14.187	36.534	14.614
CP 98-1107	17.097	19.278	13.721	17.576	9.092	12.077	4.578	14.538
CP 98-1118	16.517	17.662	16.487	19.059	5.621	11.632	25.131	14.518
CP 98-1513	19.107	15.436	13.371	15.310	7.651	13.890	28.186	14.232
CP 98-1457	17.814	17.301	12.292	18.601	7.534	11.487	5.765	14.169
CP 98-1417	15.469	15.326	13.721	15.834	8.614	11.733	6.310	13.689
Mean‡	18.015	17.980	14.873	18.706	10.003	12.377	18.118	15.326
LSD (p = 0.1)§	2.698	2.548	2.541	2.594	3.014	1.919		1.280
CV (%)††	8.993	8.504	10.267	8.329	18.095	9.308		6.500

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 1.635 TS/H at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 11. Yields of cane and of theoretical recoverable 96° sugar in metric tons per hectare (TC/H and TS/H) from first ratoon cane on Dania muck, Terra Ceia muck, Torry muck, and Malabar sand

Clone	Mean cane yield by soil type, farm, and sampling date*					Mean sugar yield by soil type, farm, and sampling date*				
	Dania muck	Terra Ceia muck	Torry muck	Malabar sand		Dania muck	Terra Ceia muck	Torry muck	Malabar sand	
	Okeelanta 12/14/03	USSC Ritta 2/19/04	Eastgate 2/19/04	Hilliard 10/30/03	Estimated yield, all farms†	Okeelanta 12/14/03	USSC Ritta 2/19/04	Eastgate 2/19/04	Hilliard 10/30/03	Estimated yield, all farms†
CP 97-1777	129.96	104.53	187.44	104.27	131.20	16.852	13.405	25.668	11.891	16.860
CP 97-1989	119.94	151.03	189.52	132.94	146.90	13.159	19.137	23.604	12.371	16.810
CP 97-2103	–	102.80	175.71	–	138.95	–	12.180	21.426	–	16.788
CP 97-1994	97.62	145.79	162.16	109.03	127.26	13.076	19.033	21.107	13.390	16.650
CP 97-1387	94.35	132.58	193.03	112.08	130.74	12.249	18.178	25.255	12.453	16.541
CP 70-1133	112.64	143.18	180.32	99.23	133.89	14.934	17.363	22.739	10.927	16.434
CP 97-1979	120.62	139.80	189.08	97.35	137.94	14.934	17.857	22.901	10.343	16.401
CP 97-1362	132.68	–	165.95	93.92	128.51	16.514	–	22.571	10.512	16.181
CP 97-1850	128.08	109.40	162.74	102.04	127.45	16.124	13.857	20.769	10.492	15.420
CP 97-2068	131.11	131.33	148.95	87.01	126.20	15.180	16.303	18.470	9.600	15.265
CP 72-2086	132.49	128.02	–	85.41	112.67	18.108	17.442	–	10.334	15.229
CP 97-1944	102.13	119.25	164.32	77.14	112.95	14.039	16.527	21.890	9.107	14.979
CP 97-1928	106.68	114.38	150.71	97.70	121.84	12.389	14.796	18.983	10.710	14.738
CP 97-1164	83.58	123.64	166.45	124.88	123.96	10.286	14.288	19.553	15.193	14.734
CP 97-1433	110.36	121.88	134.06	66.97	108.01	14.419	16.602	18.982	8.039	14.555
CP 97-1804	132.09	126.63	148.40	96.10	121.95	15.138	14.838	18.326	10.810	14.532
CP 97-1068	91.22	109.84	147.51	93.18	111.99	11.610	14.240	19.673	10.481	14.030
Mean†	114.08	125.57	165.54	99.18	126.09	14.219	16.057	21.374	11.004	15.663
LSD ($p = 0.1$)‡	31.23	24.79	23.16	15.91	13.75	3.977	3.229	3.011	1.949	1.834
CV (%)§	16.44	11.86	8.40	9.63	8.89	16.795	12.076	8.463	10.633	9.386

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Yields for locations and across locations approximated by empirical best linear unbiased predictors.
‡ *LSD* for location means of cane yield =14.50 TC/H and of sugar yield = 1.757 at $p = 0.10$.
§ *CV* = coefficient of variation.

Table 12. Theoretical recoverable yields of 96° sugar in kg per metric ton of cane (KS/T) from first-ratoon cane on Dania muck, Terra Ceia muck, Torry muck, and Malabar sand

	Mean yield by soil type, farm, and sampling date*				
	Dania muck	Terra Ceia muck	Torry muck	Malabar sand	
Clone	Okeelanta 12/14/03	USSC Ritta 2/19/04	Eastgate 2/19/04	Hilliard 10/30/03	Estimated yield, all farms†
CP 72-2086	136.9	136.1	–	120.7	133.2
CP 97-1433	131.0	136.1	138.9	122.0	132.0
CP 97-1994	134.1	131.4	130.2	122.5	131.8
CP 97-1944	136.9	138.5	133.1	120.4	131.4
CP 97-1777	129.7	128.0	136.8	114.2	126.2
CP 97-1387	130.1	137.1	130.9	110.5	125.5
CP 97-1068	127.9	129.8	133.3	112.2	124.7
CP 97-1362	125.3	–	135.9	112.5	123.5
CP 70-1133	132.0	121.9	126.6	111.1	122.7
CP 97-1850	126.1	126.6	127.7	104.4	120.5
CP 97-2103	–	119.0	122.2	–	120.5
CP 97-1164	123.9	115.0	117.8	121.5	120.1
CP 97-1928	116.7	129.3	125.9	109.6	119.7
CP 97-2068	116.3	123.3	124.0	110.0	119.6
CP 97-1804	115.3	117.1	123.8	112.7	119.5
CP 97-1979	123.9	127.6	121.2	106.8	117.1
CP 97-1989	109.9	126.9	124.7	93.0	113.3
Mean†	125.4	127.7	128.6	112.8	123.6
LSD ($p = 0.1$)‡	5.1	4.9	4.6	8.0	5.4
CV (%)§	2.5	2.3	2.1	4.3	3.0

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Yields for locations and across locations approximated by empirical best linear unbiased predictors.
‡ *LSD* for location means of sugar yield = 3.9 at $p = 0.10$.
§ *CV* = coefficient of variation.

Table 13. Yields of cane in metric tons per hectare (TC/H) from second-ratoon cane on Lauderhill muck, Terra Ceia muck, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*								
	Lauderhill muck					Terra Ceia muck	Pompano fine sand		
Clone	Knight 10/18/03	Okeelanta 10/23/03	Duda 10/24/03	SFI 10/30/03	Wedgworth 11/20/03	Osceola 10/16/03	Lykes 10/17/03	Stability†	Estimated yield, all farms‡
CP 97-1979	138.49	136.27	153.65	132.17	182.52	107.93	77.80	418.03	134.29
CP 97-1989	133.20	113.29	156.70	139.56	170.35	84.59	95.47	376.06	128.07
CP 97-1994	129.01	121.35	162.36	126.35	163.65	93.84	76.22	6.75	125.42
CP 97-1777	141.63	97.90	163.89	123.73	154.04	71.54	69.49	1036.49	115.87
CP 97-1164	89.44	109.95	142.34	126.32	170.05	86.87	68.66	265.09	113.27
CP 97-1944	112.41	116.06	123.23	127.11	148.77	107.31	70.40	2043.17	112.37
CP 70-1133	128.08	112.75	144.01	113.43	163.18	78.91	70.03	99.05	111.95
CP 97-1850	95.79	106.35	143.48	117.46	150.89	86.49	61.28	0.99	111.81
CP 97-1804	91.58	113.69	165.79	104.46	171.93	65.99	50.69	1881.57	109.31
CP 97-1362	106.08	110.22	161.99	101.80	113.61	73.48	63.92	3078.48	105.80
CP 97-1068	107.67	106.76	113.26	99.48	139.55	83.69	65.53	1105.09	105.71
CP 97-2068	110.25	121.37	171.57	103.22	125.21	71.77	42.22	3298.68	105.69
CP 97-1387	130.65	73.81	122.58	129.89	154.43	81.89	56.82	2531.04	105.00
CP 72-2086	–	111.53	108.17	90.57	138.45	67.64	–	1336.45	101.37
CP 97-1928	95.98	96.02	140.64	114.22	155.78	66.72	43.83	262.11	101.24
CP 97-2103	107.06	–	–	–	–	–	64.19	216.73	86.07
CP 97-1433	107.51	67.37	96.85	87.98	125.68	33.38	16.58	546.05	76.47
Mean‡	112.98	107.14	140.81	114.60	150.35	79.73	62.61	1088.34	109.75
LSD ($p = 0.1$)§	23.23	19.23	24.69	20.62	24.59	16.10	16.87		9.96
CV (%)††	12.35	10.78	10.52	10.80	9.82	12.13	16.18		7.20

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 13.33 TC/H at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 14. Yields of theoretical recoverable 96° sugar in kg per metric ton (KS/T) from second-ratoon cane on Lauderhill muck, Terra Ceia muck, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*								
	Lauderhill muck					Terra Ceia muck	Pompano fine sand		
Clone	Knight 10/18/03	Okeelanta 10/23/03	Duda 10/24/03	SFI 10/30/03	Wedgworth 11/20/03	Osceola 10/16/03	Lykes 10/17/03	Stability†	Estimated yield, all farms‡
CP 72-2086	–	122.7	112.8	138.6	122.3	142.3	–	15.9	127.9
CP 97-1944	102.8	132.5	117.6	140.1	117.7	136.0	118.5	257.5	123.9
CP 97-1994	94.5	127.5	111.5	140.6	114.4	146.8	102.2	79.2	120.5
CP 97-1433	97.8	120.1	108.3	143.9	116.1	141.1	100.7	81.4	118.3
CP 97-1777	94.0	116.6	109.7	133.8	120.2	137.9	98.9	61.8	115.9
CP 70-1133	93.8	118.1	105.4	131.4	111.6	139.0	102.3	8.6	114.3
CP 97-1164	88.4	122.9	108.5	131.2	112.0	132.2	105.2	104.4	114.3
CP 97-1068	91.1	115.0	102.0	132.1	111.8	138.4	86.8	25.5	111.2
CP 97-1928	85.7	110.5	100.0	135.8	113.1	144.4	89.3	244.7	110.9
CP 97-1387	84.7	112.0	111.3	130.1	112.7	131.9	91.2	104.0	110.4
CP 97-1979	90.1	110.6	105.4	128.1	109.9	137.3	89.0	38.1	110.1
CP 97-1362	86.3	114.7	99.8	123.0	109.9	136.0	99.4	89.2	109.9
CP 97-1850	91.5	111.9	99.9	123.8	116.4	128.0	94.0	193.2	109.2
CP 97-1804	73.8	112.0	101.0	128.3	111.6	129.7	99.8	31.2	108.1
CP 97-2068	83.0	105.9	102.2	127.7	98.0	123.3	86.2	138.7	102.8
CP 97-1989	77.6	101.8	98.1	123.8	85.8	133.6	86.4	527.7	101.4
CP 97-2103	85.4	–	–	–	–	–	89.9	18.0	87.7
Mean‡	89.4	115.6	105.6	131.5	111.1	135.6	96.8	118.8	112.2
LSD ($p = 0.1$)§	6.8	7.6	9.1	8.5	10.1	8.5	8.3		2.9
CV (%)††	4.6	4.0	5.2	3.9	5.5	3.8	5.2		2.4

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Stability for each clone is calculated at $p = 0.10$ by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 3.5 KS/T at $p = 0.10$.
†† *CV* = coefficient of variation.

Table 15. Yields of theoretical recoverable 96° sugar in metric tons per hectare (TS/H) from second-ratoon cane on Lauderhill muck, Terra Ceia muck, and Pompano fine sand

	Mean yield by soil type, farm, and sampling date*								
	Lauderhill muck					Terra Ceia muck	Pompano fine sand		
Stability[†]	Knight 10/18/03	Okeelanta 10/23/03	Duda 10/24/03	SFI 10/30/03	Wedgworth 11/20/03	Osceola 10/16/03	Lykes 10/17/03	Stability[†]	Estimated yield, all farms[‡]
CP 97-1994	12.192	15.516	18.128	17.886	18.954	13.859	7.795	0.441	15.134
CP 97-1979	12.467	15.070	16.277	17.056	20.316	14.772	6.995	7.330	14.831
CP 97-1944	11.540	15.424	14.522	17.950	17.406	14.607	8.325	22.137	14.077
CP 97-1777	13.390	11.500	17.749	16.652	18.519	9.852	6.914	17.197	13.348
CP 97-1164	7.935	13.540	15.532	16.720	19.081	11.358	7.234	1.798	13.072
CP 97-1989	10.379	11.664	15.437	17.146	14.681	11.441	8.303	16.674	12.938
CP 72-2086	–	13.800	12.449	12.577	16.916	9.588	–	18.278	12.858
CP 70-1133	11.977	13.384	15.300	14.907	18.257	10.950	7.205	1.426	12.849
CP 97-1850	8.769	11.917	14.382	14.605	17.697	11.046	5.866	1.528	12.282
CP 97-1387	11.105	8.241	13.724	17.002	17.501	10.771	5.212	35.168	11.802
CP 97-1804	6.744	12.773	16.730	13.425	19.123	8.556	5.045	25.394	11.797
CP 97-1068	9.860	12.264	11.575	13.213	15.645	11.586	5.764	17.389	11.722
CP 97-1362	9.218	12.598	16.228	12.495	12.782	9.962	6.357	31.262	11.430
CP 97-1928	8.224	10.617	14.033	15.528	17.624	9.643	3.938	6.391	11.222
CP 97-2068	9.187	13.024	17.322	13.163	12.329	8.813	3.648	47.505	10.790
CP 97-1433	10.352	8.222	10.682	12.643	14.589	4.721	1.647	14.040	8.938
CP 97-2103	9.155	–	–	–	–	–	5.811	1.378	7.594
Mean[‡]	10.179	12.431	14.869	15.044	16.756	10.744	6.181	15.608	12.315
LSD (p = 0.1)[§]	2.153	2.476	3.219	3.002	3.369	2.309	1.860		1.074
CV (%)[††]	12.703	11.962	13.000	11.978	12.073	12.910	18.072		7.482

* Clonal yields approximated by least squares (p = 0.10) within locations.
† Stability for each clone is calculated at p = 0.10 by Shukla's stability-variance parameter.
‡ Yields for locations and across locations approximated by empirical best linear unbiased predictors.
§ *LSD* for location means of cane yield = 1.718 TS/H at p = 0.10.
†† *CV* = coefficient of variation.

Table 16. Yields of cane and of theoretical recoverable 96° sugar metric tons per hectare (TC/H and TS/H) from second ratoon cane on Lauderhill muck, Terra Ceia muck, Torry muck, and Malabar sand

Clone	Mean cane yield by soil type, farm, and sampling date*					Mean sugar yield by soil type, farm, and sampling date*				
	Dania muck	Terra Ceia muck	Torry muck	Malabar sand		Dania muck	Terra Ceia muck	Torry muck	Malabar sand	
	Okeelanta 10/28/03	USSC Ritta 2/17/04	Eastgate 2/18/04	Hilliard 10/15/03	Estimated yield, all farms†	Okeelanta 10/28/03	USSC Ritta 2/17/04	Eastgate 2/18/04	Hilliard 10/15/03	Estimated yield, all farms†
CP 96-1171	126.55	106.02	140.67	103.02	129.10	16.383	13.867	18.714	10.369	16.142
CP 96-1602	136.12	53.27	157.48	98.07	118.22	17.904	7.239	21.321	11.458	15.375
CP 96-1252	141.31	76.93	124.31	129.26	121.44	17.597	10.195	16.553	14.078	14.658
CP 70-1133	119.63	74.40	136.28	104.93	106.34	13.897	9.381	17.055	10.928	12.494
CP 96-1350	114.97	56.48	117.24	89.96	99.43	13.699	7.356	15.935	8.547	11.865
CP 96-1253	107.65	67.35	100.43	74.43	90.68	12.682	8.206	13.164	8.574	10.869
CP 96-1865	103.40	76.37	108.80	73.47	90.41	11.677	9.242	13.988	7.898	10.685
CP 96-1290	107.95	72.41	111.56	77.29	92.46	12.031	8.224	13.639	7.491	10.552
CP 96-1288	83.96	68.52	133.50	65.82	82.45	9.895	8.940	18.042	7.526	10.515
CP 96-1686	93.12	49.78	139.89	74.46	80.35	11.535	6.738	18.158	9.466	10.295
CP 96-1300	75.08	73.34	71.85	117.23	80.84	9.273	9.837	8.981	12.384	9.528
CP 96-1161	84.87	67.69	106.02	86.62	81.73	9.785	7.981	12.979	9.015	9.313
Mean†	107.07	72.674	118.88	91.715	97.59	12.964	9.122	15.500	9.928	11.879
LSD ($p = 0.1$)‡	14.36	19.83	21.96	12.52	18.59	1.873	2.580	2.945	1.415	2.325
CV (%)§	7.99	16.91	10.93	8.24	12.44	8.634	17.260	11.248	8.664	12.861

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Yields for locations and across locations approximated by empirical best linear unbiased predictors.
‡ *LSD* for location means of cane yield =14.50 TC/H and of sugar yield = 1.757 at $p = 0.10$.
§ *CV* = coefficient of variation.

Table 17. Theoretical recoverable yields of 96° sugar in kg per metric ton of cane (KS/T) from second-ratoon cane on Lauderhill muck, Terra Ceia muck, Torry muck, and Malabar sand

	Mean yield by soil type, farm, and sampling date*				
	Dania muck	Terra Ceia muck	Torry muck	Malabar sand	
Clone	Okeelanta 10/28/03	USSC Ritta 2/14/04	Eastgate 2/18/04	Hilliard 10/15/03	Estimated yield, all farms†
CP 96-1686	129.9	136.1	127.3	124.6	129.7
CP 96-1602	135.1	135.2	117.4	131.4	129.5
CP 96-1288	135.2	130.7	114.6	117.3	125.0
CP 96-1171	133.3	130.1	100.3	129.4	123.5
CP 96-1252	132.5	132.2	109.0	125.1	122.4
CP 96-1300	124.5	133.3	105.3	124.4	121.0
CP 96-1350	136.1	129.6	95.4	119.4	119.0
CP 96-1253	129.4	121.8	115.3	118.7	118.9
CP 70-1133	125.7	126.5	104.1	116.5	118.3
CP 96-1865	128.7	120.2	107.6	113.3	117.5
CP 96-1161	122.1	117.7	104.0	116.8	115.3
CP 96-1290	122.0	114.7	97.3	111.6	113.2
Mean†	129.0	126.4	127.2	128.8	127.8
LSD ($p = 0.1$)‡	5.5	4.1	6.5	9.8	3.8
CV (%)§	2.5	1.9	3.1	4.6	7.0

* Clonal yields approximated by least squares ($p = 0.10$) within locations.
† Yields for locations and across locations approximated by empirical best linear unbiased predictors.
‡ *LSD* for location means of sugar yield = 3.9 at $p = 0.10$.
§ *CV* = coefficient of variation.

Table 18. Rankings* of clones by CP series of damage to juice quality by cold temperatures

CP 96 series†	Rank	CP97 series†	Rank	CP98 series†	Rank	CP99 series†	Rank
CP 70-1133	3	CP 70-1133	8	CP 70-1133	12	CP 72-2086	16
CP 72-2086	9	CP 72-2086	13	CP 72-2086	3	CP 89-2143	3
CP 96-1161	4	CP 97-1068	3	CP 98-1029	2	CP 99-1534	15
CP 96-1171	13	CP 97-1164	15	CP 98-1107	5	CP 99-1540	1
CP 96-1252	7	CP 97-1362	4	CP 98-1118	9	CP 99-1541	9
CP 96-1253	1	CP 97-1387	5	CP 98-1139	7	CP 99-1542	11
CP 96-1288	10	CP 97-1433‡	--	CP 98-1325	6	CP 99-1686	14
CP 96-1290	12	CP 97-1777	9	CP 98-1335	15	CP 99-1865	12
CP 96-1300	2	CP 97-1804	2	CP 98-1417	13	CP 99-1889	4
CP 96-1350	5	CP 97-1850	7	CP 98-1457	10	CP 99-1893	6
CP 96-1602	11	CP 97-1928	11	CP 98-1481	11	CP 99-1894	8
CP 96-1686	8	CP 97-1944	1	CP 98-1497	16	CP 99-1896	2
CP 96-1865	6	CP 97-1979	12	CP 98-1513	1	CP 99-1944	13
		CP 97-1989	6	CP 98-1569	14	CP 99-2084	10
		CP 97-1994	10	CP 98-1725	4	CP 99-2099	7
		CP 97-2068	16	CP 98-2047	8	CP 99-3027	5
		CP 97-2103	14				

* The lower the numerical ranking, the better the cold tolerance.

† CP 96 series cold tolerance rankings are an average of rankings from the 2000-2001 harvest season and the 2001-2002 harvest season. Clones with the same average rank were differentiated by juice purity.
CP 97 series cold tolerance rankings were based on few samples because of growth chamber malfunction.
CP 98 series are an average of rankings from the 2002-2003 harvest season and the 2003-2004 harvest season. Clones with the same average rank were differentiated by juice purity.
CP 99 series cold tolerance rankings were during the 2003-2004 harvest season.

‡ CP 97-1433 was omitted from the study because of insufficient seedcane.

Table 19. Dates of stalk counts of 10 plant cane, 10 first ratoon, and 10 second ratoon experiments

	Crop		
Location	**Plant cane**	**First ratoon**	**Second ratoon**
Duda	07/11/03	08/06/03	08/07/03
Eastgate	05/21/03	08/11/03	08/12/03
Hilliard	07/14/03	09/02/03	09/08/03
Knight	07/07/03	08/28/03	08/13/03
Lykes	07/15/03	09/04/03	09/04/03
Okeelanta	07/02/03	08/26/03	08/27/03
Okeelanta (successive)	07/08/03	08/25/03	08/22/03
Osceola	07/16/03	08/15/03	08/18/03
USSC Ritta*	--	--	--
USSC Townsite*	--	--	--
SFI	07/09/03	08/19/03	08/21/03
Wedgworth	06/30/03	07/31/03	07/31/03

* Whole plot weights were taken in lieu of plot counts at USSC Ritta and Townsite locations.

Appendix 1. Sugarcane Field Station Cultivar Development Program

Timeline	Stage	Population	Field layout	Crop age at selection	Yield and quality selection criteria	Disease* and other selection criteria	Seedcane increase scheme
Year 1	Crossing	400-600 crosses producing about 500,000 true seed	–	–	Germination tests of seed (bulk of seed stored in freezers)	Field progeny tests planted by family	–
Year 2	Seedlings (single stool stage) Seedlings start in the greenhouse from true seed of the previous year	80,000-100,000 individual plants	Transplants spaced 12 in. apart in paired rows on 5-ft. center	8-10 months	Visual selection for plant type, vigor, stalk diameter, height, density, and population; freedom from diseases	Family evaluation for general agronomic type and resistance against rust, LS, smut, etc.	One stalk cut for seed from each selected seedling
Year 3	Stage I (First clonal trial)	10,000-15,000 clonal plots	Unreplicated plots 5 ft. long on 5-ft. row spacing	9-10 months	Essentially the same selection criteria as for Seedlings stage	Permanent CP-series number assigned	Eight stalks planted for agronomic evaluation, one for RSD screening (inoculation)
Year 4	Stage II (Second clonal trial)	1,000-1,500 clones including five checks	Unreplicated 2-row plots 15 ft. long on 5-ft. row spacing	12 months	Yield estimates based on stalk number, average stalk weight, and sucrose analysis; freedom from diseases	Family evaluation for resistance to RSD and eye spot (by inoculation) and to LS, YLS, and dry top rot (by natural infection)	Eight 8-stalk bundles cut for seed; 2 stalks used for RSD screening
Year 5-6	Stage III (Regulated test; first stage planted in commercial fields)	135 clones including 2 checks† per location	Four 2-replicate tests (3 organic and 1 sand sites) on growers' farms Two-row plots, 15 ft. long	10-11 months Evaluated in plant cane and first-ratoon crops	Yield estimates based on stalk number, average stalk weight, and sucrose analysis; clonal performance assessed across locations	Disease screening (inoculation) for leaf scald, smut, mosaic virus, and RSD; also rated for other diseases (rust, etc.)	Two 8-stalk bundles cut for seed at each location
Year 7-9	Stage IV (Final replicated test; planted in commercial fields)	16 clones including 2 checks† per location	Eleven 6-replicate tests (8 organic and 3 sand sites) on growers' farms Three-row plots 35 ft. long on 5-ft. row spacing	10-15 months Analyzed in plant cane and first- and second-ratoon crops	Cane tonnage, sucrose and fiber analyses; yield estimates based on stalk number and average stalk weight	Disease screening for LS, smut, mosaic, and RSD; also rated for lodging and suitability for mechanical harvest	Initial seed increase for potential commercial release planted from first ratoon seed following evaluation in the plant cane
Year 8-11	Seedcane increase and distribution	Usually 6 or fewer clones	Plots from 0.1 to 2.0 ha	–	Seedcane purity; freedom from diseases and insects	Plots checked and certified for clonal purity and seedcane quality	Seedcane increased at 9 Stage IV locations (7 muck and 2 sand)
Soil program	Investigates soil microbial activities and plant nutrient availabilities that influence cane and sugar yields						

* LS: leaf scald; RSD: ratoon stunting; YLS: yellow leaf syndrome

† Checks in stages III and IV: CP 72-2086 (all locations), CP 78-1628 (sand soils), and CP 89-2143 (organic soils).